OFFICE OF NAVAL RESEARCH

END-OF-YEAR REPORT

PUBLICATIONS/PATENTS/PRESENTATIONS/HONORS/STUDENTS REPORT

for

GRANT: N00014-98-1-0331

PR Number 98PR04101-00

Question-driven Explanatory Reasoning About Devices that Malfunction

Principle Investigator: Arthur C. Graesser

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PART I

a. Number of papers submitted to refereed journals, but not published: 2

b. +Number of papers published in refereed journals: 12

Graesser, A.C., & Bertus, E.L. (1998). The construction of causal inferences while reading expository texts on science and technology. Scientific Studies of Reading, 2, 247-269.

Graesser, A.C., Kassler, M.A., Kreuz, R.J., & McLain-Allen, B. (1998). Verification of statements about story worlds that deviate from normal conceptions of time: What is true about *Einstein's Dreams*? Cognitive Psychology, 35, 246-301.

Wiemer-Hastings, K. & Graesser, A.C. (1998). Who needs created features? Brain and Behavior Sciences, 21, 39.

Williams, K.E., Hultman, E., & Graesser, A.C. (1998). CAT: A tool for eliciting knowledge on how to perform procedures. Behavior Research Methods, Instruments, & Computers, 30,565-572.

Zwaan, R.A., & Graesser, A.C. (1998). Constructing meaning during reading. Scientific Studies of Reading, 2, 195-198.

Graesser, A.C., Bowers, C., Olde, B., White, K., & Person, N. (1999). Who knows what: Propagation of knowledge among agents in a literary storyworld. Poetics: Journal of Empirical Research on Literature, the Media, and the Arts, 26, 143-175.

Krovi, R., Graesser, A.C., and Pracht, W.E. (1999). Agent behaviors in virtual negotiation environments. IEEE Transactions on Systems, Man, and Cybernetics, 29, 15-25.

Franklin, S.B., & Graesser, A.C. (in press). A software agent model of consciousness. Consciousness and Cognition.

Graesser, A.C., Bowers, C.A., Olde, B., & Pomeroy, V. (in press). Who said what? Source memory for narrator and character agents in literary short stories. Journal of Educational Psychology.

Magliano, J., Trabasso, T., & Graesser, A.C. (in press). Strategic processing during comprehension. Journal of Educational Psychology.

Ottati, V., Rhoads, S., & Graesser, A.C. (in press). The effect of metaphor on processing style in a persuasion task: A motivational resonance model. Journal of Personality and Social Psychology.

Wiemer-Hastings, K., & Graesser, A.C. (in press). Perceiving abstract concepts. Brain and Behavior Sciences.

c. +Number of books or chapters submitted, but not yet published: 4

d. +Number of books or chapters published: 20

Books:

Hacker, D.J., Dunlosky, J., & Graesser, A.C. (1998)(Eds.). Metacognition in educational theory and practice. Mahwah, NJ: Erlbaum.

Goldman, S., Graesser, A.C., & van den Broek, P. (1999)(Eds). Narrative comprehension, causality, and coherence. Mahwah, NJ: Erlbaum.

Chapters:

Graesser, A.C., & Tipping, P. (1998). Understanding texts. In W. Bechtel and G. Graham (Eds.), A companion to cognitive science. (pp. 324-330). Oxford: Blackwell.

Graesser, A.C., Bowers, C.A., Hacker, D.J., & Person, N. K. (1998). An anatomy of naturalistic tutoring. In K. Hogan and M. Pressley (Eds.), Scaffolding of instruction. Brookline Books.

Graesser, A.C., Kennedy, T., Wiemer-Hastings, P., & Ottati, V. (1999). The use of computational cognitive models to improve questions on surveys and questionnaires. In M.G. Sirken, D.J. Hermann, S. Schechter, N. Schwarz, J.M. Tanur, & R. Tourangeau (Eds.), Cognition and survey methods research (pp 69-86). New York: Wiley.

Graesser, A.C., Kennedy, T.., Wiemer-Hastings, P., & Ottati, V.C. (1999). The use of computational cognitive models to improve questions on surveys and questionnaires. In M.G. Sirken, T. Jabine, G. Willis, E. Martin, & C. Tucker (Eds), A new agenda for interdisciplinary survey research methods (p. 28). Hyatstsville, MD: US Department of Health and Human Services.

Person. N.K. & Graesser. A.C. (1999). Evolution of discourse in cross-age tutoring. In A.M. O'Donnell and A. King (Eds.). Cognitive perspectives on peer learning (pp.69-86). Mahwah. NJ: Erlbaum.

Graesser. A.C., Bowers. C.A., Bayen. U.J., Hu. X. (in press). Who said what? Who knows what? Tracking speakers and knowledge in narrative. In W. van Peer & S. Chatman. (Eds.). Narrative perspective: Cognition and emotion. New York: SUNY Press.

Graesser. A.C., Pomeroy. V., & Craig. S. (in press). Psychological and computational research on theme comprehension. In W. van Peer and M.M. Louwerse (Eds.). Thematics in psychology and literary studies. Albany: SUNY Press.

Graesser. A.C., & Wiemer-Hastings. K. (1999). Situation models and concepts in story comprehension. In Goldman. S.R., Graesser. A.C., and van den Broek. P. (Eds). Narrative comprehension. causality. and coherence (pp. 77-92). Mahwah. NJ: Erlbaum.

Graesser. A.C., Klettke. B., & Olde. B.A. (in press). How does the mind construct and represent stories? In M. Green. J. Strange. and T. Brock (Eds.). Narrative impact: Social and cognitive foundations. Mahwah: NJ: Erlbaum.

Graesser. A.C., Wiemer-Hastings. P., & Wiemer-Hastings. K. (in press). Constructing inferences and relations during text comprehension. In T.Sanders. J. Schilperoord. & W. Spooren (Eds.). Text representation: Linguistic and psycholinguistic aspects. Amsterdam: Benjamins.

Magliano. J.P., Zwaan. R.A., & Graesser. A.C. (1999). The role of situational continuity in narrative understanding. In S.R. Goldman and H. van Oostendorp (Eds.). The construction of mental representations during reading. Mahwah. NJ: Erlbaum.

Published Conference Proceedings:

Graesser. A.C., Franklin. S., & Wiemer-Hastings. P. and the Tutoring Research Group (1998). Simulating smooth tutorial dialogue with pedagogical value. Proceedings of the American Association for Artificial Intelligence (pp. 163-167). Menlo Park. CA: AAAI Press.

Hu. X., Graesser. A.C., and the Tutoring Research Group (1998). Using WordNet and latent semantic analysis to evaluate the conversational contributions of learners in tutorial dialog. Proceedings of the International Conference on Computers in Education, Vol. 2 (pp. 337-341). Beijing. China: Springer.

McCauley. L., Gholson. B., Hu. X., Graesser. A.C., and the Tutoring Research Group (1998). Delivering smooth tutorial dialogue using a talking head. Proceedings of the Workshop on Embodied Conversation Characters (pp. 31-38). Tahoe City. CA: AAAI and ACM.

Wiemer-Hastings. K., & Graesser. A.C. (1998). Contextual representations of abstract nouns: A neural network approach. Proceedings of the 20th Annual Conference of the Cognitive Science Society (pp. 1036-1041). Mahwah. NJ: Erlbaum.

Wiemer-Hastings. P., Graesser. A.C., & Wiemer-Hastings. K. (1998). Inferring the meaning of verbs from context. Proceedings of the 20th Annual Conference of the Cognitive Science Society (pp. 1142-1147). Mahwah. NJ: Erlbaum.

Wiemer-Hastings, P., Graesser, A.C., Harter, D., and the Tutoring Research Group (1998). The foundations and architecture of AutoTutor. Proceedings of the 4th International Conference on Intelligent Tutoring Systems (pp. 334-343). Berlin, Germany: Springer-Verlag.

Zhang, Z., Franklin, S., Olde, B., Wan, Y., & Graesser, A.C. (1998). Natural language sensing for autonomous agents. IEEE Proceedings on Intelligence and Systems.

Corbett, A., Anderson, J., Graesser, A., Koedinger, K., & van Lehn, K. (1999). Third generation computer tutors: Learn from or ignore human tutors? Proceedings of the 1999 Conference of Computer-Human Interaction (pp. 85-86). New York: ACM Press.

Olde, B.A., Hoeffner, J., Chipman, P., Graesser, A.C., and the Tutoring Research Group (1999). A connectionist model for part of speech tagging. Proceedings of the American Association for Artificial Intelligence (pp. 172-176). Menlo Park, CA: AAAI Press.

Wiemer-Hastings, P., Wiemer-Hastings, K., Graesser, A., and the Tutoring Research Group (1999). Approximate natural language understanding for an intelligent tutor. Proceedings of the American Association for Artificial Intelligence. Menlo Park, CA: AAAI Press.

e. +Number of printed technical reports/non-referred papers: 2

Graesser, A.C., & Hoeffner, J. (in press). Complex computer models are needed to understand complex learning. Contemporary Psychology.

Graesser, A.C., & Whitten, S. (in press). Review of Walter Kintsch's book, "Comprehension: A paradigm in cognition." Journal of Pragmatics.

f. +Number of patents filed: 0

g. +Number of patents granted: 0

h. +Number of invited presentations: 8

Graesser, A.C. (July, 1998). Eight cool things from the collocated conferences. Invited panel at the Fifteenth National Conference on Artificial Intelligence, Madison, WI.

Graesser, A.C., & Kreuz, R. (1998, July). Discourse in contexts of learning. Invited tutorial at the 20th Annual Conference of the Cognitive Science Society, Madison, Wisconsin.

Graesser, A.C., Craig, S., & Pomeroy, V. (1998, August). How to peddle literature to the hardnose experimental psychologist. Invited presentation at the International Association for the Empirical Studies of Literature, Art, and Media, Utrecht, the Netherlands.

Graesser, A.C. (1999, February). Deep comprehension of illustrated texts about everyday devices. Colloquium at the University of Coimbra, Coimbra, Portugal.

Graesser. A.C. (1999. February). Question-driven explanatory reasoning about devices that malfunction. Progress report to the Navy on Office of Naval Research grant. Oxford. Mississippi.

Graesser. A.C. and Hacker. D. (1999. April). AutoTutor: An automated computer tutor. Invited symposium on intelligent tutoring systems at the meetings of the American Educational Research Association. Montreal. Canada.

Graesser. A.C.. Craig. S., Pomeroy. V.. & Olde. B. (1999. April). Deep comprehension of illustrated texts in the context of a breakdown scenario. Invited symposium on discourse comprehension at the meetings of the American Educational Research Association, Montreal. Canada.

Graesser. A.C. (1999. May). Invited panel symposium on intelligent tutoring systems. Symposium at the Computer Human Interaction Conference. Pittsburgh. PA.

i. +Number of submitted presentations: 12

Graesser, A.C., Franklin. S., and the Tutoring Research Group (1998, July). The goals and design of AutoTutor. Symposium presented at the 8th Annual Meeting of the Society for Text and Discourse. Madison. Wisconsin.

Wiemer-Hastings. K., & Graesser. A.C. (1998, July). Contextual representations of abstract nouns: A neural network approach. Poster presented at the 20th Annual Conference of the Cognitive Science Society. Madison. Wisconsin.

Wiemer-Hastings. P., Graesser, A.C., & Wiemer-Hastings, K. (1998, July). Inferring the meaning of verbs from context. Poster presented at the meetings of the 20th Annual Conference of the Cognitive Science Society, Madison, Wisconsin.

Wiemer-Hastings. P., Graesser, A.C., Harter, D., and the Tutoring Research Group (1998, August). The foundations and architecture of AutoTutor. Paper presented at the 4th International Conference on Intelligent Tutoring Systems, An Antonio. Texas.

Hu. X.. Graesser. A.C.. and the Tutoring Research Group (1998, October). Using WordNet and latent semantic analysis to evaluate the conversational contributions of learners in tutorial dialog. Paper presented at the International Conference on Computers in Education, Beijing, China.

McCauley, L., Gholson, B., Hu, X., Graesser, A.C., and the Tutoring Research Group (1998, October). Delivering smooth tutorial dialogue using a talking head. Paper presented at the Workshop on Embodied Conversation Characters (AAAI and ACM). Tahoe City, CA.

Wiemer-Hastings. K., Wiemer-Hastings, P., & Graesser, A. C. (1998, November). The more, the better? The effect of the number of input variables on generalization in neural networks. Paper presented at the 28th Annual Conference of the Society for Computers in Psychology. Dallas, Texas.

Wiemer-Hastings, P., Wiemer-Hastings, K., & Graesser, A.C. (1999, January). Using latent semantic analysis to evaluate tutee contributions. Paper presented at the Tenth Annual Meeting of the Winter Conference on Discourse, Text & Cognition, Jackson Hole, Wyoming.

Graesser, A.C., Pomeroy, V., & Craig, S. (1999, January). Think aloud protocols in the context of illustrated texts and devices that malfunction. Paper presented at the Tenth Annual Meeting of the Winter Conference on Discourse, Text & Cognition, Jackson Hole, Wyoming.

Olde, B.A., Hoeffner, J., Chipman, P., Graesser, A.C., and the Tutoring Research Group (1999, May). A connectionist model for part of speech tagging. Paper presented at the 12th International Florida Artificial Intelligence Research Conference, Orlando, Florida.

Wiemer-Hastings, P., Wiemer-Hastings, K., and Graesser, A. (1999, May). Approximate natural language understanding for an intelligent tutor. Paper presented at the 12th International Florida Artificial Intelligence Research Conference, Orlando, Florida. *

Corbett, A., Anderson, J., Graesser, A., Koedinger, K., & van Lehn, K. (1999, May). Third generation computer tutors: Learn from or ignore human tutors? Panel symposium at the 1999 Computer-Human Interaction Conference, Pittsburgh, PA.

j. +Honors/Awards/Prizes for contract/grant employees: 3

Board of Visitors Eminent Faculty Award, University of Memphis, May, 1999.

Editor of the journal Discourse Processes, 1997-2004.

1999 Program Chair for Division C (Learning and Instruction) of the American Educational Research Association Conference, Montreal Canada, April 1999.

k. +Total number of Full-time equivalent Graduate Students and Post-Doctoral associates supported during this period, under the PR number:

Graduate students: 2 (1 female, 1 male, 0 Asian, 0 Minority)
Post-doctoral Associates: 0

l. Other funding

All of the following projects investigate question asking and question answering mechanisms, which is the direct focus of the ONR grant.

National Science Foundation, Simulating tutors with natural dialog and pedagogical strategies, 1997-2000, $900,000 (Dr. Graesser is PI, $210,000 received this year). This project involves developing an automated computer tutor (called AutoTutor) that asks and answers questions; question asking and answering is the direct focus of the ONR grant, so the projects are quite related. Also, both projects involve the technical domains; the NSF grant tutors students on computer literacy whereas the ONR grant investigates mechanical and electronic devices.

United States Bureau of Census. QUEST questionnaire evaluation tool. 1998-1999. $58.512 (Dr. Graesser is PI: $30.000 received this year). This project involves building a computer tool that critiques questions on surveys and questionnaires. Question asking and answering is the direct focus of the ONR grant so these projects are quite related.

National Institutes of Health. Smoking cessation in the elderly. 1998-2001. $1.600.000 (Dr. Bob Klesges is PI). As a co-PI. my role is to recommend changes on the question asking. question answering. and discourse interaction styles of health educators who try to get elderly smokers to stop smoking. Question asking and answering mechanisms are investigated in both the ONR and NIH projects.

Office of Naval Research. Intelligent distributed agents. 1998-2002. $1.500.000 (Dr. Stan Franklin is PI). As a co-PI. my role is to advise graduate students how to design question asking and question answering interfaces on software agents. and how to evaluate the system performance.

PART II

a. Principal Investigator: Arthur C. Graesser

b. Telephone Number: (901) 678-2742

c. ONR Program Officer: Jan Dickieson

d. Program objective:

The goal of this project is to investigate how adults reason about everyday devices (e.g., locks, doorbells, dishwashers, clutches) when the devices break down. Deep comprehension of a device is presumably manifested by reasoning in the face of the malfunctioning device, because the comprehender has to diagnose the fault and figure out how to correct it. The primary hypothesis is that good comprehenders will ask and answer good questions. A good question is defined as a question that identifies a plausible fault that causally explains the breakdown. A bad question addresses irrelevant content that does not provide a likely explanation of the malfunction.

We collected data from 108 college students at the University of Memphis. The participants read 6 illustrated texts on everyday devices: a cylinder lock, an electronic bell, a car temperature gauge, a clutch, a toaster, and a dishwasher. The device mechanisms were extracted from a book with illustrated texts, ***The Way Things Work*** (Macaulay, 1988). After reading about each device, the participants subsequently received scenarios in which the device breaks down (e.g., in the context of a cylinder lock, suppose that the key turns, but the bolt does not move). During this time, they are asked either to "think aloud" or to generate questions for two minutes while attempting to diagnose and repair the malfunctions. We examined the questions that learners ask and answer when they are given the breakdown scenario. We measured the volume and quality of the content produced during the question asking or think aloud task. The content of the questions was also mapped onto conceptual graph structures (e.g., semantic networks, knowledge structures) for the illustrated texts on devices; these structures include component hierarchies, spatial region hierarchies, causal chains/networks, goal/plan/action hierarchies, and property descriptions that are depicted in either text or picture form

After providing the question asking and think aloud protocols for all 6 devices, the participants completed an objective test on their understanding of the devices. This consisted of six 3-alternative, forced-choice questions about each device (36 total questions). Following this objective test of device comprehension, participants completed a battery of tests that measured their cognitive abilities and personality. The tests of cognitive ability include the ASVAB (the Armed Services Vocational Aptitude Battery), working memory span, spatial reasoning, and exposure to print. Male and female participants also completed the NEO inventory, which measures individuals on the "big five" personality factors: neuroticism, extroversion, openness, agreeableness, and

conscientiousness. We examined whether these measures of individual differences could predict comprehension scores and measures of question asking.

e. Significant Results during the Last Year

The results of the study supported the hypothesis that deep comprehenders of devices ask good questions when confronted a breakdown scenario. Mechanical comprehension and gender were the two most robust predictors of both the device comprehension scores (predicting 44% of the variance) and the quality of questions in the question asking task (predicting 38% of the variance) when multiple regression analyses were conducted. The profile of correlations with question quality were nearly identical with the profile of correlations with device comprehension scores. Question quality is therefore an excellent litmus test of how well a college student understands the mechanisms underlying a device. The volume of content in the question asking task and the think aloud task is a poor index of deep comprehension. Similarly, the quality of content in the think aloud task is also not a good index of deep comprehension. The questions asked by students with high mechanical comprehension scores had two characteristics: (a) the questions converged on components in the mechanism that are plausible faults and (b) the questions had a more fine-grained elaboration of the parts, processes, and relations that specified how the breakdown occurred. Stated differently, there was high convergence and high mechanistic detail.

f. Summary of Plans for Next Year's Work

Experiments will be conducted that collect eye tracking data from college students while they read illustrated texts about everyday devices, and while they generate questions when these devices break down. Participants with high mechanical comprehension are predicted to have their eye fixations concentrate on faulty components and processes whereas those with low mechanical reasoning should have more undiscriminating patterns of eye fixations. More generally, we will relate the patterns of eye tracking to elements in the illustrated texts, to nodes in the conceptual graph structures, and to measures of individual differences. We will investigate the cognitive mechanisms that explain question asking and eye fixations in the context of a breakdown scenario. There is a more practical implication: A quick way to find out whether a sailor has a talent for understanding or operating a device is to present a break down scenario and to record the sailor's question asking behavior and eye fixations.

g. Names of Graduate Students Currently Working on the Project:

Victoria Pomeroy
Brent Olde
Shulan Lu (starting July, 1999)

PART III

These are the three view graphs: An introductory 5-part viewgraph and two supporting viewgraphs. The paragraph descriptions are below. A Powerpoint file with the graphs is in a separate file.

VIEWGRAPH 1

The goal of this project is to investigate how adults reason about everyday devices (e.g., locks, doorbells, dishwashers, clutches) when the devices break down. Deep comprehension of a device is presumably manifested by reasoning in the face of the malfunctioning device, because the comprehender has to diagnose the fault and figure out how to correct it. The primary hypothesis is that good comprehenders will ask and answer good questions. A good question is defined as a question that identifies a plausible fault that causally explains the breakdown. A bad question addresses irrelevant content that does not provide a likely explanation of the malfunction. We collected data from 108 college students at the University of Memphis. The participants read 6 illustrated texts on everyday devices: a cylinder lock, an electronic bell, a car temperature gauge, a clutch, a toaster, and a dishwasher. The device mechanisms were extracted from a book with illustrated texts, ***The Way Things Work*** (Macaulay, 1988). After reading about each device, the participants subsequently received scenarios in which the device breaks down (e.g., in the context of a cylinder lock, suppose that the key turns, but the bolt does not move). During this time, they are asked either to "think aloud" or to generate questions for two minutes while attempting to diagnose and repair the malfunctions. We examined the questions that learners ask and answer when they are given the breakdown scenario. We measured the volume and quality of the content produced during the question asking or think aloud task. These were correlated with scores on a device comprehension test and 20 measures of individual differences.

VIEWGRAPH 2

The results of the study supported the hypothesis that deep comprehenders of devices ask good questions when confronted a breakdown scenario. Mechanical comprehension and gender were the two most robust predictors of both the device comprehension scores (predicting 44% of the variance) and the quality of questions in the question asking (QA) task (predicting 38% of the variance) when multiple regression analyses were conducted. The profile of correlations with question quality were nearly identical with the profile of correlations with device comprehension scores. Question quality is therefore an excellent litmus test of how well a college student understands the mechanisms underlying a device. The volume of content in the question asking task and the think aloud (TA) task was a poor index of deep comprehension. Similarly, the quality of content in the think aloud task is also not a good index of deep comprehension.

VIEWGRAPH 3

The content of the questions was also mapped onto conceptual graph structures (e.g., semantic networks, knowledge structures) for the illustrated texts on devices; these structures include component hierarchies, spatial region hierarchies, causal chains/networks, goal/plan/action hierarchies, and property descriptions that are depicted in either text (T) or picture form (P). The questions asked by students with high mechanical comprehension scores had two characteristics: (a) the questions converged on components in the mechanism that are plausible faults and (b) the questions had a more fine-grained elaboration of the parts, processes, and relations that specified how the breakdown occurred. Stated differently, there was high convergence and high mechanistic detail. In the Powerpoint figure, the nodes with red dots are the likely faults for the breakdown scenario (The key turns but the bolt does not move).

Question-driven Explanatory Reasoning About Devices that Malfunction

OBJECTIVE

To assess whether an adult has a deep comprehension of a device.
To explore the cognitive mechanisms that underlie deep comprehension of illustrated texts.
To develop models of human question asking and answering

APPROACH

Give breakdown scenarios after college students read illustrated texts from *The Way Things Work.*
Collect question asking and think aloud protocols in the context of a breakdown scenario.
Collect measures of cognitive ability and personality.

ACCOMPLISHMENTS

Participants with high mechanical comprehension ask good questions.
Good questions converge on faults and dissect processes.

TRANSITIONS

Next project collects eye tracking data.
Patterns of eye movements should quickly manifest deep comprehension

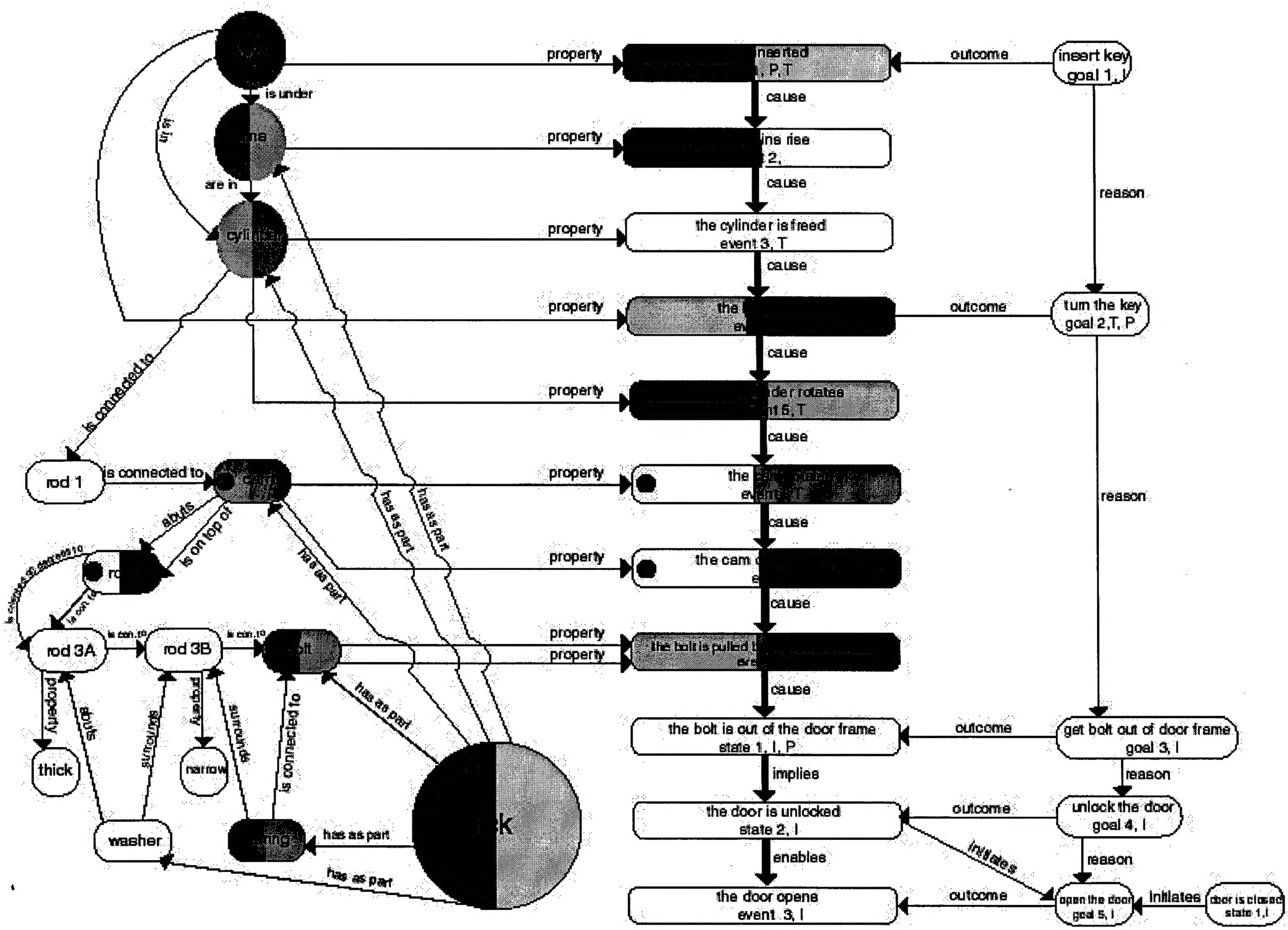
CORRELATIONS

PREDICTOR	DEVICE COMPR.	QUALITY QA	TA
Spatial reasoning	.46	.42	.22
Working memory	.01	.04	-.08
Print Exposure (ART)	.27	.30	-.04
ASVAB (g)	.59	.41	.18
Mechanical comprehension	.63	.56	.30
Electronics	.56	.52	.36
General science	.60	.48	.24
Auto & Shop	.52	.40	.32
Mathematics knowledge	.56	.45	.18
Arithmetic reasoning	.52	.37	.11
Numerical operations	.12	.10	.10
Word knowledge	.42	.29	.09
Paragraph comprehension	.27	.11	.21
Coding speed	.08	-.08	.07
Gender	.37	.37	.30
Age	.01	.01	-.08
Openness (NEO)	.32	.24	.08
Neuroticism	-.08	.04	-.07
Extroversion	-.01	-.03	-.03
Agreeableness	-.03	-.12	-.04
Conscientiousness	-.01	-.04	.01

r = /.19/ is significant at $p < .05$.

QUESTIONS ABOUT A CYLINDER LOCK

Mechanical Comprehension =	HIGH	LOW
Is it the right key?	6	5
What kind of lock is it?	0	3
Is the spring broken?	5	5
Does spring keep bolt from moving?	3	0
Is the spring pulling back the bolt?	2	0
Is the spring making the bolt get stuck?	2	0
Is the cam broken?	6	2
Is the cam moving?	2	2
Is the cam moving back the bolt?	2	0
Is the bar that fits under cam broken?	4	0
Is the cam disconnected/out-of-synch with the cylinder?	5	0
Is the cylinder turning?	3	2
Is the cylinder turning the cam?	2	0
Is the bolt stuck in the slot?	3	3
Is the bolt connected to the bar?	2	0
Are the pins broken?	4	2
Do the pins lift right?	3	2
What are the pins used for?	0	2
Number if participants	11	11



insert key
goal 1, I
outcome
reason
turn the key
goal 2,T, P
get bolt out of door frame
goal 3, I
unlock the door
goal 4, I
open the door
goal 5, I
door is closed
state 1, I
initiates
the cylinder is freed
event 3, T
the bolt is out of the door frame
state 1, I, P
the door is unlocked
state 2, I
the door opens
event 3, I
cause
implies
enables
property
is under
are in
is in
is connected to
rod 1
abuts
is on top of
rod 3A
rod 3B
thick
narrow
washer
surrounds
has as part